

IN THE CLAIMS

The following is a complete listing of the claims, and replaces all earlier versions and listings.

1. (Currently Amended) ~~Method~~ A method of sending an original information sequence, including:
 - an encoding operation $[(E1)]$, ~~consisting~~ of encoding ~~said the~~ original information sequence by means of an error correction code, so as to obtain a sequence of encoded symbols;
 - a frequency mapping operation $[(E2)]$, ~~consisting~~ of associating with the sequence of encoded symbols K frequency symbols in a frequency space consisting of an ordered series of 2^p increasing frequencies, periodically spaced apart and associated with an amplitude, each of ~~said the~~ K frequency symbols representing N encoded symbols, p, K and N being strictly positive integers;
 - an inverse transformation operation $[(E3)]$, ~~consisting~~ of applying to the K frequency symbols a reversible transformation including a multiplication by an invertible matrix of size $N \times N$, so as to obtain inverse transform signals; and
 - a transmission operation $[(E4)]$, ~~consisting~~ of sending over a transmission channel signals obtained from ~~said the~~ inverse transform signals;

~~characterised in that~~ in which there exists a K-tuplet of positive integers n_1, n_2, \dots, n_K , at least one of which is strictly positive, such that, for an integer i varying from 1 to K, after periodic extraction of one frequency out of 2^{n_i} amongst the frequencies of the i^{th} of ~~said the~~ K frequency symbols, thus forming a reduced frequency symbol with 2^{p-n_i} frequencies, a set

of K reduced frequency symbols is obtained, representing ~~said~~ the original information sequence, with a view to a complete or partial decoding.

2. (Currently Amended) ~~Sending~~ The method according to Claim 1, characterised in that which there exists a strictly positive integer n such that, after periodic extraction of one frequency out of 2^n amongst the frequencies of each of ~~said~~ the K frequency symbols, thus forming a reduced frequency symbol with 2^{p-n} frequencies, there is obtained a set of K reduced frequency symbols representing ~~said~~ the original information sequence.

3. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, characterised in that said encoding operation (E1) includes at least one systematic recursive convolutional encoding operation.

4. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, characterised in that which said encoding operation $[(E1)]$ is a turbo-encoding operation.

5. (Currently Amended) ~~Sending~~ The method according to ~~claim~~ Claim 1 or 2, characterised in that which said reverse transformation operation $[(E3)]$ is an inverse fast discrete Fourier transformation operation.

6. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, in which ~~said~~ the original information sequence has a length ℓ , ~~characterised in that~~ which a value of N is chosen which is both a power of 2 and equal to 4ℓ .

7. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, ~~characterised in that~~ which said encoding operation $[(E1)]$ is a turbo-encoding operation with two parities and, during said frequency mapping operation $[(E2)]$, for each block of four successive frequencies, corresponding respectively to four sub-carriers:

~~the~~ a systematic output (x) obtained at the end of the turbo-encoding operation is associated with ~~the~~ a first available sub-carrier, in the sense of the lowest frequency in the block;

~~the~~ an output with ~~the~~ a second parity (y2) obtained at the end of the turbo-encoding operation is associated with ~~the~~ a second sub-carrier in the block;

~~the~~ an output with ~~the~~ a first parity (y1) obtained at the end of the turbo-encoding operation is associated with ~~the~~ a third sub-carrier in the block; and

the systematic output (x) is also associated with ~~the~~ a fourth available sub-carrier, in the sense of the highest frequency in the block.

8. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, ~~characterised in that~~ which said encoding operation $[(E1)]$ is a turbo-encoding operation with three parities and ~~in that~~, during said frequency mapping operation $[(E2)]$, for each block of four successive frequencies, corresponding respectively to four sub-carriers:

the a systematic output (x) obtained at the end of the turbo-encoding operation is associated with the a first available sub-carrier, in the sense of the lowest frequency in the block;

the an output with the a second parity (y2) obtained at the end of the turbo-encoding operation is associated with the a second sub-carrier in the block;

the an output with the first parity (y1) obtained at the end of the turbo-encoding operation is associated with the a third sub-carrier in the block; and

the an output with the a third parity (y3) obtained at the end of the turbo-encoding operation is associated with the a fourth available sub-carrier, in the sense of the highest frequency in the block.

9. (Currently Amended) ~~Sending~~ The method according to Claim 1 or 2, characterised in that it uses in which a modulation of the OFDM type is used.

10. (Currently Amended) ~~Device~~ A device for sending an original information sequence, having:

encoding means (~~30; 90~~), for encoding ~~said~~ the original information sequence by means of an error correction code, so as to obtain a sequence of coded symbols;

frequency mapping means (~~32; 92~~), for associating with ~~said~~ the sequence of encoded symbols K frequency symbols in a frequency space consisting of an ordered sequence of 2^p increasing frequencies periodically spaced apart and associated with

an amplitude, each of ~~said~~ the K frequency symbols representing N encoded symbols, p, K and N being strictly positive integers;

inverse transformation means ~~(34; 94)~~, for applying to ~~said~~ the K frequency symbols a reversible transformation including a multiplication by an invertible matrix with a size NxN, so as to obtain inverse transform signals; and

transmission means ~~(36; 96)~~, for sending over a transmission channel signals obtained from ~~said~~ the inverse transform signals; ~~characterised in that~~ in which there exists a K-tuplet of positive integers n_1, n_2, \dots, n_K , at least one of which is strictly positive, such that, for an integer i varying from 1 to K, after periodic extraction of one frequency out of 2^{n_i} amongst the frequencies of the i^{th} of ~~said~~ the K frequency symbols, thus forming a reduced frequency symbol with 2^{P-n_i} frequencies, a set of K reduced frequency symbols is obtained, representing ~~said~~ the original information sequence, with a view to a complete or partial decoding.

11. (Currently Amended) ~~Sending~~ The device according to Claim 10, ~~characterised in that~~ which there exists a strictly positive integer n such that, after periodic extraction of one frequency out of 2^n amongst the frequencies of each of ~~said~~ the K frequency symbols, thus forming a reduced frequency symbol with 2^{P-n} frequencies, there is obtained a set of K reduced frequency symbols representing ~~said~~ the original information sequence.

12. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that which said encoding means ~~(30; 90)~~ ~~include~~ includes at least first systematic recursive convolutional encoding means.

13. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that which said encoding means ~~(30; 90)~~ ~~are~~ comprises turbo-encoding means.

14. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that which said reverse transformation means ~~(34; 94)~~ ~~are~~ comprises inverse fast discrete Fourier transformation means.

15. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, in which ~~said~~ the original information sequence has a length ℓ , characterised in that, for said predetermined number (N), a value is chosen which is both a power of 2 and equal to 4ℓ .

16. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that which said encoding means ~~(30)~~ ~~are~~ comprise turbo-encoding means with two parities and ~~in that~~ said frequency mapping means $[(32)]$ associate, for each block of four successive frequencies, corresponding respectively to four sub-carriers:

~~the~~ a systematic output (x) of ~~the~~ said turbo-encoding means with ~~the~~ a first available sub-carrier, in the sense of the lowest frequency in the block;

the an output with the a second parity (y2) of the said turbo-encoding means with the a second sub-carrier in the block;

the an output with the a first parity (y1) of the said turbo-encoding means with the a third sub-carrier in the block; and

the systematic output (x) also with the a fourth available sub-carrier, in the sense of the highest frequency in the block.

17. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that which said encoding means ~~(90)~~ are comprises turbo-encoding means with three parities and ~~in that~~ said frequency mapping means ~~[[(92)]]~~ associates, for each block of four frequencies, corresponding respectively to four sub-carriers:

the a systematic output (x) of the said turbo-encoding means with the a first available sub-carrier, in the sense of the lowest frequency in the block;

the an output with the a second parity (y2) of the said turbo-encoding means with the a second sub-carrier in the block;

the an output with the a first parity (y1) of the said turbo-encoding means with the a third sub-carrier in the block; and

the an output with the a third parity (y3) of the said turbo-encoding means with the a fourth available sub-carrier, in the sense of the highest frequency in the block.

18. (Currently Amended) ~~Sending~~ The device according to Claim 10 or 11, characterised in that it uses in which a modulation of the OFDM type is used.

19. (Currently Amended) ~~Method~~ A method of receiving signals representing an original information sequence sent by means of a transmission method according to Claim 1 or 2, ~~characterised in that~~ which, from a K-tuplet of granularity equal to positive integers n'_1, n'_2, \dots, n'_K such that each integer n'_i is less than or equal to ~~said the~~ integer n_i , said reception method includes:

an operation_s of receiving the K frequency symbols sent by means of said transmission method;

an extraction operation ~~consisting~~, for each integer i varying from 1 to K, of periodically extracting one frequency out of 2^{n_i} amongst the frequencies of the i^{th} of ~~said the~~ K frequency symbols received, thus forming a reduced frequency symbol with 2^{p-n_i} frequencies;

a transformation operation (~~E6; E10; E14~~) ~~consisting~~, for each integer i varying from 1 to K, of applying to ~~said the~~ reduced frequency symbol with 2^{p-n_i} frequencies, a reversible transformation including a multiplication by an invertible matrix of size $2^{p-n'_i} \times 2^{p-n'_i}$; and

an operation_s of decoding (~~E8; E12; E16~~) all the K reduced frequency symbols with $2^{p-n'_i}$ frequencies, thus forming a decoded information sequence.

20. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that said~~ in which the K-tuplet of granularity is determined during a choosing operation.

21. (Currently Amended) **Reception** The reception method according to Claim 19, ~~said~~ the original information sequence having been sent by means of a sending method according to Claim 2, ~~characterised in that~~ which, from a granularity equal to a positive integer n' less than or equal to said integer n , said reception method includes:

- an operation₁ of receiving K frequency symbols sent by means of ~~the~~ the ~~aforementioned~~ said transmission method;
- an extraction operation, ~~consisting of~~ periodically extracting one sequence out of $2^{n'}$ amongst the frequencies of each of ~~said~~ the K frequency symbols received, thus forming a reduced frequency symbol with $2^{p-n'}$ frequencies;
- a transformation operation (~~E6; E10; E14~~), ~~consisting of~~ applying, to each of ~~said~~ the K reduced frequency symbols with $2^{p-n'}$ frequencies, a reversible transformation including a multiplication by an invertible matrix of size $2^{p-n'} \times 2^{p-n'}$; and
- an operation₂ of decoding (~~E8; E12; E16~~) all the K reduced frequency symbols with $2^{p-n'}$ frequencies, thus forming a decoded information sequence.

22. (Currently Amended) **Reception** The reception method according to Claim 21, ~~characterised in that~~ which said granularity is determined during a choosing operation.

23. (Currently Amended) **Reception** The reception method according to Claim 20, ~~characterised in that~~ which said choosing operation ~~consists of~~ includes choosing said granularity so as to be the greater, the better the reception quality.

24. (Currently Amended) ~~Reception~~ The reception method according to Claim 20, ~~characterised in that~~ which said choosing operation ~~consists of~~ includes choosing said granularity from a look-up table giving ~~the~~ possible granularity values as a function of signal to noise ratios.

25. (Canceled)

26. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that~~ which said transformation operation (~~E6; E10; E14~~) is a direct fast discrete Fourier transformation operation.

27. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that~~ in which said decoding operation (~~E8; E12; E16~~) ~~consists of~~ includes decoding ~~said the~~ set of reduced frequency symbols according to a decoding technique which is a function of said granularity.

28. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that~~ which said decoding operation ~~[(E8)]~~ is a turbo-decoding operation.

29. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that~~ which said decoding operation ~~[(E12)]~~ is a Viterbi decoding operation.

30. (Currently Amended) ~~Reception~~ The reception method according to Claim 19, ~~characterised in that~~ which said decoding operation $[(E16)]$ is a threshold decoding operation.

31. (Currently Amended) ~~Device~~ A device for receiving signals representing an original information sequence sent by a sending device according to Claim 10 or 11, ~~characterised in that~~ which, from a K-tuplet of granularity equal to positive integers n'_1, n'_2, \dots, n'_K such that each integer n'_i is less than or equal to ~~said~~ the integer n_i , said reception device has:

transformation means ~~(40, 50, 60)~~, for applying, for each integer i varying from 1 to K , to ~~said~~ the reduced frequency symbol with 2^{p-n_i} frequencies, a reversible transformation including a multiplication by an invertible matrix of size $2^{p-n_i} \times 2^{p-n_i}$; and

decoding means ~~(44, 54, 64)~~ for decoding all the K reduced frequency symbols with 2^{p-n_i} frequencies, thus forming a decoded information sequence.

32. (Currently Amended) ~~Reception~~ The device according to Claim 31, ~~characterised in that~~ which said K-tuplet of granularity is determined using choosing means.

33. and 34. (Canceled)

35. (Currently Amended) ~~Reception~~ The device according to Claim 32, characterised in that which said choosing means choose said granularity so as to be the greater, the better the reception quality.

36. (Currently Amended) ~~Reception~~ The device according to Claim 32, characterised in that which said choosing means choose said granularity from a look-up table giving the possible granularity values as a function of signal to noise ratios.

37. (Currently Amended) ~~Reception~~ The device according to Claim 32, characterised in that which said choosing means choose said granularity from a look-up table giving the possible granularity values as a function of the a distance between a sender having a sending device according to any one of Claims 10 to 18 and a receiver having said reception device.

38. (Currently Amended) ~~Reception~~ The device according to Claim 31, characterised in that which said transformation means ~~(40, 50, 60)~~ are comprise direct fast discrete Fourier transformation means.

39. (Currently Amended) ~~Reception~~ The device according to Claim 31, characterised in that which said decoding means ~~(44, 54, 64)~~ decode said the set of reduced frequency symbols according to a decoding technique which is a function of said granularity.

40. (Currently Amended) ~~Reception~~ The device according to Claim 31, characterised in that which said decoding means (44) ~~are~~ comprise turbo-decoding means.

41. (Currently Amended) ~~Reception~~ The device according to Claim 31, characterised in that which said decoding means (54) ~~are~~ comprise Viterbi decoding means.

42. (Currently Amended) ~~Reception~~ The device according to Claim 31, characterised in that which said decoding means (64) ~~are~~ comprise threshold decoding means.

43. (Currently Amended) ~~Digital~~ A digital signal processing apparatus, characterised in that it has having means adapted to implement a sending method according to Claim 1 or 2.

44. (Currently Amended) ~~Digital~~ A digital signal processing apparatus, characterised in that it has having means adapted to implement a reception method according to Claim 19.

45. (Currently Amended) ~~Digital~~ A digital signal processing apparatus, characterised in that it has having a sending device according to Claim 10 or 11.

46. (Currently Amended) ~~Digital~~ A digital signal processing apparatus, characterised in that it has having a reception device according to Claim 31.

47. (Currently Amended) ~~Telecommunications~~ A telecommunications network, ~~characterised in that it has~~ having means adapted to implement a sending method according to Claim 1 or 2.

48. (Currently Amended) ~~Telecommunications~~ A telecommunications network, ~~characterised in that it has~~ having means adapted to implement a reception method according to Claim 19.

49. (Currently Amended) ~~Telecommunications~~ A telecommunications network, ~~characterised in that it has~~ having a sending device according to Claim 10 or 11.

50. (Currently Amended) ~~Telecommunications~~ A telecommunications network, ~~characterised in that it has~~ having an information reception device according to Claim 31.

51. (Currently Amended) ~~Mobile~~ A mobile station in a telecommunications network, ~~characterised in that it has~~ having means adapted to implement a sending method according to Claim 1 or 2.

52. (Currently Amended) ~~Mobile~~ A mobile station in a telecommunications network, ~~characterised in that it has~~ having means adapted to implement a reception method according to Claim 19.

53. (Currently Amended) ~~Mobile~~ A mobile station in a telecommunications network, ~~characterised in that it has~~ having a sending device according to Claim 10 or 11.

54. (Currently Amended) ~~Mobile~~ A mobile station in a telecommunications network, ~~characterised in that it has~~ having a reception device according to Claim 31.

55. (Currently Amended) Information storage means which can be read by a computer or microprocessor storing instructions of a computer program, ~~characterised in that it~~ in which said information storage means implements a sending method according to Claim 1 or 2.

56. (Currently Amended) Information storage means which can be read by a computer or microprocessor storing instructions of a computer program, ~~characterised in that it~~ in which said information storage means implements a reception method according to Claim 19.

57. (Currently Amended) Information storage means which is removable, partially or totally, and which can be read by a computer or microprocessor storing instructions of a computer program, ~~characterised in that it~~ in which said information storage means implements a sending method according to Claim 1 or 2.

58. (Currently Amended) Information storage means which is removable, partially or totally, and which can be read by a computer or microprocessor storing instructions of a computer program, ~~characterised in that it~~ in which said information storage means implements a reception method according to Claim 19.

59. (Currently Amended) ~~Computer~~ A computer program product, ~~characterised in that it comprises~~ comprising software code portions for implementing a sending method according to Claim 1 or 2.

60. (Currently Amended) ~~Computer~~ A computer program product, ~~characterised in that it comprises~~ comprising software code portions for implementing a reception method according to Claim 19.

61. (New) A method for communicating, on a transmission channel, signals representing an original information sequence, the method comprising:

sending the original information sequence, including:

an encoding operation, of encoding the original information sequence by means of an error correction code, so as to obtain a sequence of encoded symbols,

a frequency mapping operation, of associating with the sequence of encoded symbols K frequency symbols in a frequency space consisting of an ordered series of 2^p increasing frequencies, periodically spaced apart and associated with an amplitude,

each of the K frequency symbols representing N encoded symbols, p, K and N being strictly positive integers,

an inverse transformation operation, of applying to the K frequency symbols a reversible transformation including a multiplication by an invertible matrix of size $N \times N$, so as to obtain inverse transform signals, and

a transmission operation, of sending over a transmission channel signals obtained from the inverse transform signals in which there exists a K-tuplet of positive integers n_1, n_2, \dots, n_K , at least one of which is strictly positive, such that, for an integer i varying from 1 to K, after periodic extraction of one frequency out of 2^{n_i} amongst the frequencies of the i^{th} of the K frequency symbols, thus forming a reduced frequency symbol with 2^{p-n_i} frequencies, a set of K reduced frequency symbols is obtained, representing the original information sequence, with a view to a complete or partial decoding; and

receiving the signals representing the original information sequence sent by said sending, in which, from a K-tuplet of granularity equal to positive integers n'_1, n'_2, \dots, n'_K such that each integer n'_i is less than or equal to the integer n_i , said method includes:

an operation, of receiving the K frequency symbols sent by said sending,

an extraction operation, for each integer i varying from 1 to K, of periodically extracting one frequency out of 2^{n_i} amongst the frequencies of the i^{th} of the K frequency symbols received, thus forming a reduced frequency symbol with 2^{p-n_i} frequencies,

a transformation operation, for each integer i varying from 1 to K ,
of applying to the reduced frequency symbol with 2^{p-n^i} frequencies, a reversible
transformation including a multiplication by an invertible matrix of size $2^{p-n^i} \times 2^{p-n^i}$, and
an operation, of decoding all the K reduced frequency symbols with
 2^{p-n^i} frequencies, thus forming a decoded information sequence.